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The Effects of DHEA on Resilience to PTSD

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Dehydroepiandrosterone (DHEA) is a neurochemical steroid released in the brain during acute and chronic stresses. Neurosteroids, such as DHEA, have considerable effects on mood and well-being via effects on neurotransmitter receptors in the brain. The release of cortisol over extended periods of time has detrimental effects on the body such as memory loss and suppression of the immune system. DHEA may help prevent the detrimental effects of increased cortisol secretion. Measuring DHEA may be a potential method the military can use to identify Soldiers at risk for developing PTSD as well as identify those who may be resilient.

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THE EFFECTS OF DHEA ON RESILIENCE TO PTSD

ABSTRACT

Dehydroepiandrosterone (DHEA) is a neurochemical steroid released in the brain during acute and chronic stresses. Neurosteroids, such as DHEA, have considerable effects on mood and well-being via effects on neurotransmitter receptors in the brain. The release of cortisol over extended periods of time has detrimental effects on the body such as memory loss and suppression of the immune system. DHEA may help prevent the detrimental effects of increased cortisol secretion. Measuring DHEA may be a potential method the military can use to identify Soldiers at risk for developing PTSD as well as identify those who may be resilient.

THE EFFECTS OF DHEA ON RESILIENCE TO PTSD

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Introduction

A major mental health problem the military is currently facing is posttraumatic stress disorder (PTSD). If Soldiers are diagnosed with a psychological disorder, the military may lose combat-ready Soldiers who are essential to accomplishing their mission in the current war. It is important to understand what biological mechanisms contribute to an individual's capacity to be resilient under conditions of extreme stress, such as those regularly experienced by Soldiers. The purpose of this paper is to propose a new method the military can use to identify Soldiers at risk for developing PTSD as well as identify those who may be resilient.

Review of Psychological Consequences of Combat Exposure

Resilience

This paper will first address resilience and why it is important attribute to have in life. Currently there are several definitions for resilience; however, the general agreement is it is the ability for individuals to healthily overcome stress or adversity (Richman & Fraser, 2001). When an individual is exposed to a stressful situation they may demonstrate remarkable resilience by dealing with the situation and remaining healthy, or they may suffer physical and mental health decrements (Bartone, 2006). Resilience is a vital characteristic to possess both in the military and civilian world because it allows one to perform the job to the best of one’s ability.

The military exposes Soldiers to a variety of stressors including deployments, death and family separation. Military personnel must be resilient to handle these stressors and perform their duty (Castro & Adler, 1999). Civilian workers must also be resilient because sixty percent of men and fifty percent of women will be exposed to at least one traumatic event in their lifetime (Breslau, Chilcoat, Kessler, Peterson, & Lucia, 1999). Approximately 15 to 20 percent of these individuals will develop posttraumatic stress disorder (PTSD), especially, firemen, policemen

and other emergency personnel who are exposed daily to stressful and traumatic events (Breslau, Chilcoat, Kessler, Schultz, Davis, & Andreski, 1998). Increasing an individual's resilience is important so that Soldiers can complete their duties to the best of their ability.

One way to reduce an individual's stress level is to decrease the frequency and duration of work, also allowing more recovery time. Nonetheless, it is not always feasible since some situations require continuous operations and extreme efforts. For example, "following the September 11th terrorist strike on the World Trade Center, fire, police, and other emergency personnel necessarily maintained continuous operations around the clock with the goal of locating possible survivors, as well as restoring essential services to the affected areas" (Bartone, 2006). Operations like September 11th and others show the importance of resilience and why it is vital to study it as well as discover ways to minimize or counter the stressors associated with such operations.

Since resilience sits within the individual it is difficult to predict who will and will not demonstrate it. Over the years researchers have conducted studies in order to discover a tool for predicting resilience. One predictor is the idea that individuals with a cohesive family, by means of close relationships and stable home environments, are likely to have better resilience than those who have a non-cohesive family (King, King, Vogt, Knight, & Samper, 2006). Another thought is that individuals who acquire a positive self-concept may be well able to maintain competence under a range of seemingly different kinds of adversities (Olsson, Bond, Burns, Vella-Brodrick, & Sawyer, 2003). Additionally, researchers have developed systems such as the Healthy Kids Resilience Assessment and the Post-combat Mental Health Assessment to provide resilience measurement devices (Constantine, Benard, & Diaz, 1999). Using these tools, an indication of the individual's resilience can be gained; but they will never apply to every

individual due to everyone being different. This leads to the next topic this paper will discuss which is Post Traumatic Stress Disorder (PTSD).

PTSD

If an individual has low resilience and is exposed to an extremely traumatic stress event they may develop PTSD. A traumatic event is defined as an event that involves actual or threatened death or injury to oneself or to others; this includes but is not limited to combat, disaster, and rape or repeated trauma such as: prisons, concentration camps, and slave labor camps (Herman, 1992). An example of a traumatic event is the terrorist attacks on the World Trade Center and the Pentagon on September 11, 2001, which represented a combination of interpersonal violence, loss, and disaster. “Tens of thousands of people ran for their lives in fear, were exposed to graphic scenes of death, or lost loved ones” (Yehuda, 2002). The survivors of traumatic events, such as September 11, may develop symptoms of PTSD.

PTSD symptoms include re-experiencing of the traumatic event, avoidance of trauma-relevant stimuli and numbing of general responsiveness, in addition to heightened physiological arousal (McFall, Murburg, Smith, & Jensen, 1991). Re-experiencing symptoms means the individual is having unwanted recollections of the incident in the form of distressing images, nightmares, or flashbacks (Yehuda, 2002). Avoidance and numbing means the individual is trying to avoid reminders of the event, including persons, places, or even thoughts associated with the incident (Yehuda, 2002). Hyperarousal refers to physiological manifestations, such as insomnia, irritability, impaired concentration, hypervigilance, and increased startle reactions (Yehuda, 2002). While having only one of these symptoms can change people’s lives in order to be diagnosed with PTSD, their symptoms must cause clinically significant distress or impairment in social, occupational or other important areas of function and be enduring for at least one

month (Zatzick, Marmar, Weiss, & Browner, 1997). PTSD can significantly impair someone's life and, therefore, it is important to identify, as early as possible, who is at risk for developing PTSD and who may require treatment.

Over the years researchers have developed different PTSD assessment tools. For example, one study suggests that individuals with higher levels of peritraumatic dissociation and more severe depression, anxiety, and intrusive symptoms were at higher risk for developing PTSD (Shalev, Peri, Canetti, & Schreiber, 1996). Another predictor is the CAPS-1, a structured interview, used for assessing the frequency and intensity of each PTSD symptom. "The CAPS-1 yields both continuous and dichotomous scores for current and lifetime PTSD symptoms" (Blake, Weathers, Nagy, Kaloupek, & Gusman, 1995). While all the predictor tools are good, PTSD is still a serious issue in the military, especially with all the current deployments.

Stress

Stress can be defined many ways. It is described as a stimulus, a response to a stimulus, or as the effects of the response on the individual (Agius, Blenkin, Deary, Zealley, & Wood, 1996). In our context, we can illustrate stress as an environmental variable, whether physical, emotional, or psychological, that has the potential to affect performance. It can be explained as the consequence of the failure to respond appropriately to emotional or physical threats, whether actual or imagined (Le Fevre et al, 2003). Stress can be categorized into negative stress, *distress*, or positive stress, *eustress*. Distress causes performance decrement, and can cause maladaptive traits, dispositions, behaviors, and disorders to become more prevalent. However, not all stress is bad; individuals need a certain level of stress in order to perform at an optimal level on a given task. With too little stress, an individual will become bored and complacent and will perform at a lower level. Similarly, with too much stress, performance will degrade. Eustress is positive

stress. It causes individuals to display adaptive behaviors and traits and leads to optimal performance (Gmelch, 1983).

Stress can be measured in a wide variety of ways. It can be observed from an environmental, psychological, or biological standpoint (Cohen, Kessler, & Gordon, 1997). When stress is measured using environmental means, the role and effect of an external stimulus on the individual and his performance is measured. The most common means of measuring stress using an environmental metric is the study of significant life events (e.g., graduation, severe injury or illness, marriage, birth of a child, and death of a family member) and their effects on individuals. This can be done subjectively by having participants self-report their feelings about the event and the effect they believe it has on their performance (in any facet; work, athletic, and driving an automobile) and their health. Objective measures may also be collected either by gathering data related to the subject's performance or health, or by simply observing these variables. A psychological approach to stress measurement may focus on subjective feedback from an individual (i.e. how do individuals *feel* the external stimulus is affecting them and their performance). Perception of stress varies by individual, and how a person perceives a stimulus is integral to the level of stress that stimulus will elicit. The biological method of stress measurement includes the physical and psychological effects of stress on specific areas and systems of the human body. Common areas of study are the effects of stress on the central nervous system (CNS), the activation of the autonomic nervous system (ANS) and its subcomponent, the sympathetic nervous system (SNS), which becomes most active when the body is under stress. Additionally, hormones such as epinephrine, adrenaline, and cortisol play important roles in the body's response to stress, as well as activation of certain areas of the brain, like the hypothalamic-pituitary-adrenal axis (HPA axis) (Kemeny, 2003).

Perception plays a key role in the effect of stress on an individual. Distress is generally caused when a stimulus is perceived as being a threat or danger, with negative outcomes and consequences. Eustress may occur when a stimulus is perceived as a challenge from which positive outcomes are possible. A situation that may cause distress in one individual may elicit eustress in another. An event that one person may view as threatening may be perceived by another as a challenge from which benefits can be derived. For example, imagine two boxers preparing for a championship fight. One of the fighters is the two-time defending champion, and may view the fight as a threatening event/stimulus, because losing the fight means losing the title and damaging the boxer's reputation. The champion stands everything to lose, and little to gain, as the contender is relatively unknown, and by defeating the contender the champion proves nothing. For the defending champion, the upcoming fight is a significant source of distress. Constant worrying over the fight may negatively affect the champion's training efforts, causing the boxer to perform at a lower level. The other fighter, though, an up and coming but relatively unknown boxer, eagerly awaits the upcoming match. For the contender, the fight is a chance to win the title and make one's reputation as a skilled and serious boxer. By fighting the champion, the contender has nothing to lose and everything to gain. For the contender, the fight is a source of eustress. The contender's ambition and motivation, spurred by the thought of the upcoming fight, acts as a driving force for performance. This enables the contender to train and perform at an optimal level.

A new and promising method of studying stress and its effects on Soldiers in combat is the positive psychology approach. In the past, researchers have used the negative psychology approach to studying the stress of combat and the post traumatic stress disorder (PTSD) that sometimes results from prolonged stress (Matthews, 2008). The negative psychology approach

focuses on studying the harmful aspects of a phenomenon. For stress, some of these include; PTSD and other psychological disorders, illness, poor performance, and negative/maladaptive personality traits, dispositions, and behaviors, amongst many others. Negative psychology has a role in the study of combat stress in helping diagnose and treat Soldiers who demonstrate adverse reactions to stress and develop stress related disorders, but this is the minority of Soldiers. Most Soldiers deploy to combat, serve their combat tour, and then return to the United States without experiencing PTSD, because the military as a whole is a very resilient population (Matthews, 2008). Positive psychology "…explores factors that contribute to health, excellence, and flourishing" (Matthews, 2008). The positive psychology approach attempts to explain human success in the face of adversity, and resilience to stress, by investigating human strengths and other factors that lead to positive outcomes. Research in the area of combat stress using the positive psychology approach holds great promise for the military. The information gathered can be used to improve resilience training for Soldiers, lowering incidences of PTSD and other negative side-effects of combat stress.

The control of stress, at both the individual and unit level, is of paramount importance to the Army. The extreme environment of combat presents Soldiers with many unique and severe stressors. Environmental, psychological, and biological stress levels are all very high. Combat troops are often pushed to their physical, mental, and emotional limits, and beyond. With the current tempo of combat operations in Iraq and Afghanistan, the amount of stress placed on Soldiers is at the highest level it has been since the Vietnam War. This makes research in the area of stress and its effects on Soldiers, both good and bad, more important than ever.

Maladaptive Behavior

Combat deployments are by nature highly stressful in every aspect; environmentally, psychologically, and biologically. Soldiers will be pushed to their limits physically, mentally, and emotionally. There are many positive, adaptive stress reactions that can enhance individual and unit performance during combat operations (e.g., unit cohesion and loyalty can lead to extreme acts of bravery in the face of danger and death). Often in the worst of situations, the periods of most intense combat, the highest unit cohesion, teamwork, and greatest acts of selfless bravery, courage and heroism are seen (Appy, 1993). However, prolonged acute stress from combat can cause Soldiers to exhibit negative psychological symptoms and behaviors, called maladaptive stress reactions. Maladaptive stress reactions can be characterized as either combat and operational stress reactions (COSRs) or misconduct stress behaviors (Department of the Army, 2006). Combat and operational stress reactions are typically short-term reactions to the acute trauma of combat or the cumulative effect of the chronic stressors of long-term deployments. COSRs may have symptoms reflective of many psychiatric disorders, such as depression, panic, and anxiety, but the effects are typically temporary. These symptoms may soon disappear for Soldiers without a history of these disorders, but others may need treatment if the reactions continue for an extended period of time. While COSRs tend to be psychological or biological side effects of combat stress, misconduct stress reactions often manifest as behavioral side effects. Misconduct stress reactions can include the disobeying of orders, the breaking of rules and regulations, drug and alcohol abuse, desertion or going away without leave (AWOL) and in extreme cases, war crimes such as killing innocent civilians. Misconduct stress reactions are most likely to occur in units with ill-trained or disciplined Soldiers, but even well-trained and led units are susceptible. In some cases, a highly cohesive unit may be particularly vulnerable to

misconduct stress reactions (Department of the Army, 2006). Imagine the impact on morale and discipline the death of a popular NCO or officer would have. The Soldiers would be out for revenge after the killing, especially in a counterinsurgency setting where it is difficult to identify friend from foe. This scenario (the death of a popular leader causing Soldiers to seek revenge) is essentially what contributed to the My Lai massacre in Vietnam and the Haditha killings in Iraq.

In order to prevent maladaptive stress reactions and minimize their effects in theater, as well as treat Soldiers who demonstrate symptoms of combat and operational stress reactions and misconduct stress behaviors, the Army developed a field manual for combat and operational stress control (Department of the Army, 2006). Mental health professionals, to include psychiatrists and clinical psychologists who specialize in PTSD and combat stress, as well as other mental health specialists and support personnel, are assigned to deployed units. They are given the difficult task of reducing and preventing maladaptive stress reactions and maximizing adaptive stress reactions. Much of the responsibility for identifying Soldiers demonstrating maladaptive stress reactions falls not on mental health professionals, who can not realistically assess every Soldier in the unit while deployed to a combat zone, but on the Soldiers themselves. Soldiers must have the moral courage to identify their friends and peers who are suffering from COSRs or misconduct stress behaviors, and encourage them, or if necessary, force them to get help. This is a continuous process, as Soldiers must be trained and familiarized in the procedures of COSC pre-deployment, and mental health professionals must be able to diagnose and treat Soldiers suffering from maladaptive stress reactions not only during combat deployments, but also post-deployment in the garrison environment.

Army Relevance

The Army is a small community, as Lieutenant General Caslen, the 70th Commandant of Cadets for the United States Military Academy, reminds the Corps of Cadets during briefings: "Less than one half of one percent of the entire United States population sign up to serve their country." Additionally, retaining Soldiers is a challenge currently because of the low retention rate as a result of being deployed repeatedly to support the war in Iraq and Afghanistan. In the CRS Report for Congress, "the Army currently projects an officer shortage of nearly 3,000 in FY2007… and estimates that annual shortages in excess of 3,000 officers will persist through FY2013" (Henning, 2006). Not only does the stress of deployment decrease retention rates it also increases the number of psychological problems Soldiers are developing. "The prevalence of reporting a mental health problem was 19.1% among service members returning from Iraq compared with 11.3% after returning from Afghanistan and 8.5% after returning from other locations" (Hoge, Auchterlonie, & Milliken, 2006). Soldiers often face harsh environmental conditions - hot or cold, wet or dry - and often the terrain is rugged. In Afghanistan, the ground forces have to wage sustained combat at high altitude. Troops have to confront, and overcome the hobbling effects of altitude sickness while encumbered with 80 pounds of gear and negotiate their way across steep snow-covered slopes. During yearlong deployments, Soldiers not only deal with combat stress, they also have to handle the stress from maintaining their relationships and caring about their families. Additionally, it is stressful for Soldiers on a moral and ethical level because there are no clear combatants and the responsibility and guilt of possibly killing civilians on the battlefield can have lasting effects.

Review and Analysis of DHEA

In part, these effects may be associated with dehydroepiandrosterone (DHEA), which is a neurochemical steroid released in the brain during acute and chronic stresses. Neurosteroids, such as DHEA, have considerable effects on mood and well-being via effects on neurotransmitter receptors in the brain (Allolio, & Arlt, 2002). When individuals experience a stressful situation their bodies respond biologically to protect themselves. The hypothalamus secretes corticotropin-releasing factor (CRF), which induces the release of adrenocorticotropin hormone (ACTH). ACTH stimulates the release of cortisol, in addition to dehydroepiandrosterone (DHEA) from the adrenal gland (Ozbay, Johnson, Dimoulas, Morgan III, Charney, & Southwick, 2007). The release of cortisol over extended periods of time has detrimental effects on the body such as memory loss and suppression of the immune system (McEwen, 1998; Bell, 2001). These negative effects of cortisol are seen more in chronically stressed participants who usually have a significantly larger increase in cortisol compared to unstressed participants (Schulz, Kirshbaum, PruBner, & Hellhammer, 1998). DHEA helps prevent such damages from the increased cortisol secretion. The mean DHEA plasma level in humans is 2.7 ng/ml (Buster & Abraham, 1972).

Studies show that DHEA potentially promotes resilience and decreases the likelihood of PTSD (Charney, 2004). A decrease in DHEA may contribute to the increase in vulnerability of damage to the stressed human brain (Connor, 2006; Kimonides, Khatibi, Svendsen, Sofroniew, & Herbert, 1998). "DHEA and DHEA-S play a significant role in normal function of neuronal cells and that supplementation with them may prevent neuronal loss and/or damage" (Bologa, Sharma, & Roberts, 2004). Research into the biology of PTSD in adults has received considerable attention in the past decade. New technology such as high-resolution magnetic

resonance imaging (MRI) has made it possible to obtain accurate volume measurements of certain brain regions. Research proposes that stress and the glucocorticoids secreted by the adrenal steroids during stress can damage the hippocampus (Sapolsky, Romero, & Munck, 2000). Therefore, a higher level of DHEA is beneficial to combating the biological damages caused by elevated levels of stress, and extended periods of time with high cortisol levels can damage the body, specifically the human brain.

A study conducted on special operations Soldiers enrolled in the military Combat Diver Qualification Course (CDQC) showed that Soldiers with higher levels of DHEA did better during the final underwater navigation exam than those with less DHEA (Morgan, Rasmusson, Pietrzak, Coric, & Southwick, 2009). During this study "the baseline values of DHEA were directly correlated to superior performance in the underwater navigation exam. DHEA was also significantly and negatively related to stress-induced symptoms of dissociation during performance of the task. Similarly, participants who reported fewer symptoms of dissociation exhibited superior military performance and increased levels of DHEA after the test" (Morgan III, Rasmusson, Pietrzak, Coric, & Southwick, 2009).

Other studies have found a negative correlation between DHEA levels and PTSD symptom severity in women (Ozbay, Johnson, Dimoulas, Morgan III, Charney, & Southwick, 2007). This is important because it supports the idea that when an individual is exposed to an extremely stressful scenario, DHEA is important to ameliorate stress and promote resilience. Nonetheless, in a young adult human DHEA, together with DHEAS, is the most abundant steroid in the blood (Berr, Lafont, Dubuire, Dartigues, & Baulieu, 1996). DHEA levels peak around age 20 and then gradually decline and by age 70 individuals have only about 20 percent of the peak levels circulating in their body (Kimonides, Khatibi, Svendsen, Sofroniew, & Herbert, 1998).

While the DHEAS levels in the body decrease, the serum cortisol concentration is maintained therefore increasing the negative effects of corsitol discussed earlier in this paper (Berr, Lafont, Dubuire, Dartigues, & Baulieu, 1996). DHEA levels are directly related to stress tolerance and DHEA levels decrease with age, therefore there is an increased demand for older Soldiers to be more carefully monitored for PTSD.

Proposed Study Method

Participants

The proposed study would include 100 Soldiers from each of the eight Brigade Combat Teams (BCT) that are participating in the Comprehensive Soldier Fitness (CSF) research project. We suggest that blood samples be taken from each of the participants, to test for DHEA plasma levels using radioimmunoassay (Berr, Lafont, Dubuire, Dartigues, & Baulieu, 1996).

Apparatus

The participants will have their blood drawn and tested for DHEA levels at 6 month intervals. The advantage of this metric is the relative simplicity and ease of use; the blood can even be drawn in a field or deployed environment. All that is needed to take blood samples from participants is a medic, basic medical supplies, test tubes, and a cooler or refrigerator to keep the blood cold. The medic will take a couple of test tubes of blood from each participant. If the participant cannot give blood, the medic can take a saliva sample; from which DHEA levels can be obtained (McCraty, Barrios-Choplin, Rozman, Atkinson, & Watkins, 2007; Smyth, Ockenfels, Porter, Kirschbaum, Hellhammer, & Stone, 1998). DHEA plasma levels could be measured using radioimmunoassay, a “highly specific DHEA antiserum combined with a one step celite microcolumn chromatographic system to measure the DHEA steroid accurately in small aliquots of plasma” (Buster, & Abraham, 1972; Hankinson, Willett, Manson, Colditz,

Hunter, Spiegelman, & Barbieri, 1998). Additionally, this process is highly sensitive, and may be subject to error.

Procedure

Since higher DHEA levels are correlated with better resilience, the military should use DHEA as a metric to determine if the CSF resilience training is effective. The DHEA plasma levels of each Soldier could then be stored in a database, along with the Soldier's other medical information. This information would be useful for mental health professionals to have access to in order to better facilitate pre-deployment resilience training. Using DHEA levels to assess a Soldier's level of resilience to PTSD fits into the CSF resilience training protocols as a form of physiological assessment. We hypothesize that the mean DHEA level of the brigades that receive CSF training will be higher than those that did not receive training. If this hypothesis is supported, it is another indicator that DHEA levels are an important biological factor in resilience.

The military may be able to identify individuals at risk for PTSD by measuring the amount of DHEA plasma in Soldier's blood or saliva. Blood is a good test for DHEA levels because DHEA-S serum level in human beings is the highest of all steroids and research shows that DHEA levels are correlated with serum DHEA-S levels (Berr, Lafont, Dubuire, Dartigues, & Baulieu, 1996; Nestler, Isiskin, Barlascini, Welty, Clore, & Blackard, 1989). There is strong evidence that low DHEA levels relate to a higher vulnerability to PTSD.

Future Research

An area of possible future study is to expand the testing of DHEA levels to the entire Army. Every Soldier has a blood sample drawn during basic training to test for AIDS. This sample could also be used to test for DHEA plasma levels. The Soldier's DHEA level can be

saved into a computer by the individual's Social Security number (SSN). If the Soldier develops PTSD later in their career the military could enter the Soldier's SSN to look up his or her DHEA levels. With enough data the researchers could determine if there is a possible link between low DHEA plasma levels and PTSD. Finally, DHEA levels could be used as a screening criterion for Soldiers thought to be at risk for developing PTSD. These at risk Soldiers could receive extra resilience training, and hopefully this could reduce the number of Soldiers who develop PTSD.

Additional future research could be conducted on DHEA supplementation. Circulating levels of DHEA are associated with individual difference in emotionality, cognitive functioning, health, and behavior. Therefore the ability to keep DHEA within an optimal range during stress exposure should enhance the ability of an individual to be resilient and decrease PTSD (Brown, Casciot, & Papadopoulos, 2001). DHEA supplementation could have invaluable benefits for Soldiers and this may allow the military to retain more combat-ready and mentally healthy Soldiers.

Annotated References

Agius, R. M., Blenkin, H., Deary, I. J., Zealley, H. E., & Wood, R. A. (1996). Survey of perceived stress and work demands of consultant doctors. *Occupational and Environmental Medicine*, *53*(4), 217-224.

This article assesses work demands as potential stressors of health service consultants, and describes the development of tools for measuring their stress experiences.

Allolio, B., & Arlt, W. (2002). DHEA treatment: Myth or reality? *Trends in Endocrinology and Metabolism, 13*(7), 288-294.

This article talks about how DHEA concentrations decline with advancing age. DHEA acts as a neurosteroid and affects an individual's mood and well-being by affecting neurotransmitter receptors in the brain.

Appy, C. G. (1993). *Working-Class War: American Combat Soldiers and Vietnam*. Chapel Hill, NC: The University of North Carolina Press.

This book attempts to portray the experience of the average American Soldier in the Vietnam War, not the officers from an upper-class background, but the enlisted Soldiers drawn predominantly from the lower or working classes.

Bartone, P. T. (2006). Resilience under military operational stress: Can leaders influence hardiness? *Military Psychology*, *18*(3), 131-148.

This article talked about personality hardiness as one of several potential "pathways to resilience." The author argued that leaders in military units may be able to foster increases in the kinds of cognitions and behaviors that typify the high-hardy person's response to stressful circumstances.

Bell, C. (2001). Cultivating resiliency in youth. *Journal of Adolescent Health, 29*(5), 375-381.

This article discusses stress and the importance of resilence to prevent PTSD. In this study they talk about the effect of cortisol and how it can cause problems with short-term memory.

Berr, C., Lafont, S., Dubuire, B., Dartigues, J., & Baulieu, E. (1996). Relationships of dehydroepiandrosterone sulfate in the elderly with functional, psychological, and mental status, and short-term mortality: A French community-based study. *PNAS*, *93*(23), 13410-13415.

This article discusses a study conducted on the DHEA levels of 622 subjects over 65 years of age, studied for 4 years. The study confirmed the continuing decrease of DHEAS serum concentration with age.

Blake, D. D., Weathers, F. W., Nagy, L. M., Kaloupek, D. G., & Gusman, F. D. (1995). The development of a clinician-administered PTSD scale. *Journal of Traumatic Stress*, *8*(1), 75-90.

This article discusses various interview processes used to measure PTSD. It concludes that the Clinician-Administered PTSD Scale (CAPS-1) is the most effective of these, and describes the metrics the CAPS-1 uses to assess PTSD. The article also notes the reliability and validity of this process.

Bologa, L., Sharma, J., & Roberts, E. (2004). Dehydroepiandrosterone and its sulfate derivative reduce neuronal death and enhance astrocytic differentiation in brain cell cultures. *Journal of Neuroscience Research*, *17*(3), 225-234.

This paper was about a human study of dehydroepiandrosterone (DHEA) and dehydroepiandrosterone sulfate (DHEA-S) measurement. Studies have shown age-related changes in DHEA(S) levels that decrease after puberty in females and after 20-24 yr of age in males. The study proposes that DHEA and DHEA-S play a significant role in normal function of neuronal cells and that supplementation may prevent neuronal loss and/or damage.

Breslau, N., Chilcoat, H. D., Kessler, R. C., Schultz, L. R., Davis, G. C., & Andreski, P. (1998). Trauma and posttraumatic stress disorder in the community: The 1996 Detroit area survey of trauma. *Archives of General Psychiatry*, *55*(7), 626-632.

This article was about a study that researched specific types of traumas and their prevalence and risk of leading to posttraumatic stress disorder (PTSD). The study found that not only can combat, rape, and other assaultive violence cause PTSD so can the sudden, unexpected death of a loved one.

Breslau, N., Chilcoat, H. D., Kessler, R. C., Peterson, E. L., & Lucia, V. C. (1999). Vulnerability to assaultive violence: Further specification of the sex difference in post-traumatic stress disorder. *Psychological Medicine*, *29*(4), 813-821.

This article is about gender and likelihood of developing PTSD. This study found that although females are less likely to experience a traumatic event. Those that do experience a traumatic event are more likely to develop PTSD then a male because of the difference in the trauma type, such as rape.

Brown, R. C., Casciot, C., & Papadopoulos, V. (2001). Pathways of neurosteroid biosynthesis in cell lines from the human brain. *Journal of Neurochemistry*, *74*(2), 847-859.

This article discusses the process behind neuroactive steroids production within the human brain. It also discusses possible ways to increase the production of DHEA.

Buster, J. E., & Abraham, G. E. (1972). Radioimmunoassay of Plasma Dehydroepiandrosterone. *Analytical Letters*, *5*(4), 203-215.

This report discusses the methods of measuring DHEA in plasma. Is this study they used a highly specific DHEA antiserum combined with a one step celite microcolumn chromatographic system, to measure this DHEA accurately in small aliquots of plasma from both male and female subjects.

Castro, C. A., & Adler, A. B. (1999). OPTEMPO: Effects on Soldier and unit readiness. *Parameters: US Army War College*, *29*(3), 86-95.

This article talked about the effects of operations tempo (OPTEMPO), the rate of military actions or missions, on Soldier and unit readiness of the United States Army in Europe.

Charney, D. S. (2004). Psychobiological mechanisms of resilience and vulnerability: Implications for successful adaptation to extreme stress. *The American Journal of Psychiatry, 161*, 195-216.

This study identified eleven neurochemical, neuropeptide, and hormonal mediators as possibly related to resilience or vulnerability. One of the eleven neurochemicals was DHEA, an adrenal steroid released under stress, and it may decrease the severity of PTSD.

Cohen, S., Kessler, R. C., & Gordon, L. (1997). *Measuring Stress: A Guide for Health and Social Scientists*. New York: Oxford University Press.

This book provides a guide for measuring different types of stress. The book provides a broad definition for stress, and groups stress into three classifications: environmental, psychological, or biological. The biological type of stress is most useful for our research.

Connor, K. M. (2006). Assessment of resilience in the aftermath of trauma. *Journal of Clinical Psychiatry, 67*(suppl 2) 46-49.

This article discussed several neurochemicals including DHEA and their possible ability to promote resilience. It also talks about characteristics of resilience such as a strong sense of self-esteem and displaying an action-oriented approach toward problem solving.

Constantine, N.A., Benard, B., & Diaz, M. (1999). Measuring protective factors and resilience traits in youth: The healthy kids resilience assessment. *Paper presented at the Seventh Annual Meeting of the Society for Prevention Research, New Orleans, LA.*

This paper focused on The *Healthy Kids Resilience Assessment* which is a survey used to assess and understand a variety of external and internal resilience factors associated with positive youth development. It examines the network of relationships between protective factors, resilience traits, health promoting behaviors, and other positive developmental outcomes.

Department of the Army (June 2006). *Combat and Operational Stress Control*. FM 4-02.51.

This is the U.S. Army field manual which outlines the processes and procedures for dealing with the effects of combat stress on units. The goal is to minimize the negative/maladaptive effects of stress on Soldiers, while maximizing the positive effects such as unit cohesion.

Gmelch, W. H. (1983). Stress for success: How to optimize your performance. *Theory Into Practice*, *22*(1), 7-14.

This article explores the linkage between stress and performance. The researchers searched for ways to produce the proper amount of stress for optimum stimulation and performance.

Hankinson, S. E., Willett, W. C., Manson, J. E., Colditz, G. A., Hunter, D. J., Spiegelman, D., & Barbieri, R. L. (1998). Plasma sex steroid hormone levels and risk of breast cancer in postmenopausal women. *Journal of the National Cancer Institute, 90*, 1292-1299.

This article discusses the relationships between sex steroid hormone levels in plasma, including DHEA, and risk of breast cancer in postmenopausal women. This study discusses how DHEA plasma levels were measured in the blood using radioimmunoassay.

Henning, C. A. (2006, July 5). *Army Officer Shortages: Background and Issues for Congress*. Retrieved April 24, 2010, from http://www.fas.org/sgp/crs/natsec/RL33518.pdf

This article discusses the shortage of personnel in the Army. The article states the Army will need to improve its recruiting and retention rates to improve this shortage.

Herman, J. L. (1992). Complex PTSD: A syndrome in survivors of prolonged and repeated trauma. *Journal of Traumatic Stress, 5*(3), 377-391.

This article talked about the development of post-traumatic disorder in survivors of prolonged, repeated trauma such as captivity. It discussed how PTSD does not only occur from a single traumatic event but can also form from prolonged stressful experiences.

Hoge, C. W., Auchterlonie, J. L., & Milliken, C. S. (2006). Mental health problems, use of mental health services, and attrition from military service after returning from deployment to Iraq or Afghanistan. *The Journal of the American Medical Association*, *295*(9), 1023-1032.

This article talked about the mental health problems seen in the military from service members returning from Iraq, Afghanistan and other deployment locations.

Kemeny, M. E. (2003). The psychobiology of stress. *Current Directions in Psychological Science, 12*(4), 124-129.

This article covers the relationships of the central nervous system (CNS), autonomic nervous system (ANS), and sympathetic nervous system (SNS) with regards to each other when the body is under stress. It also incorporates a discussion of the various subsystems (such as the HPA axis) and hormones (like adrenaline and cortisol) that play a key role in the body's stress response.

Kimonides, V. G., Khatibi, N. H., Svendsen, C. N., Sofroniew, M. V., & Herbert, J. (1998). Dehydroepiandrosterone (DHEA) and DHEA-sulfate (DHEAS) protect hippocampal neurons against excitatory amino acid-induced neurotoxicity. *The National Academy of Sciences*, *95*(4), 1852-1857.

This article reports on DHEA and how it is the most abundant steroid in the blood of young human adults. It also discusses how DHEA levels decline with age and during certain types of illness or stress.

King, L. A., King, D. W., Vogt, D. S., Knight, J., & Samper, R. E. (2006). Deployment risk and resilience inventory: A collection of measures for studying deployment-related experiences of military personnel and veterans. *Military Psychology*, *18*(2), 89-120.

This article describes the development of a way to assess key psychosocial risk and resilience factors for military personnel deployed to a hazardous environment. This study looks at predeployment factors (childhood family environment), deployment or war-zone factors (concerns about life and family disruptions, deployment social support, combat experiences) and postdeployment factors (postdeployment stressors).

LeFevre, M., Matheny, J., & Kolt, G. S. (2003). Eustress, distress, and interpretation in occupational stress. *Journal of Managerial Psychology*, *18*(7), 726-744.

This study examined the concepts of stress, distress and eustress and how the word stress has shifted from Selye's original formulation.

Matthews, M. D. (2008). Positive psychology: Adaptation, leadership, and performance in exceptional circumstances. In P.A. Hancock & J.L. Szalma (Eds.), *Performance Under Stress*. (pp. 163-180). Burlington, VT: Ashgate Publishing Company.

This paper investigates the potential for applying the positive psychology approach to the study of PTSD, especially in the military context.

McCraty, R., Barrios-Choplin, B., Rozman, D., Atkinson, M., & Watkins, A. D. (2007). The impact of a new emotional self-management program on stress, emotions, heart rate variability, DHEA and cortisol. *Integrative Psychological and Behavioral Science, 33*(2), 151-170.

This article examined the effects of a new emotional self-management program on healthy adults. The researchers measured salivary DHEA/DHEAS and cortisol levels. Autonomic nervous system function was assessed by heart rate variability analysis, and emotions were measured using a psychological questionnaire.

McEwen, B. S. (1998). Protective and damaging effects of stress mediators. *The New England Journal of Medicine*, *338*(3), 171-179.

This article reviews the long-term effect of allostatic load which is the physiologic response to stress. During allostasis the autonomic nervous system, the hypothalamic–pituitary–adrenal (HPA) axis, and the cardiovascular, metabolic, and immune systems protect the body by responding to internal and external stress.

McFall, M. E., Murburg, M. M., Smith, D. E., & Jensen, C. F. (1991). An analysis of criteria used by VA clinicians to diagnose combat-related PTSD. *Journal of Traumatic Stress*, *4*(1), 123-136.

This study examined the diagnostic criteria for post-traumatic stress disorder (PTSD). In the study psychiatrists and psychologists were surveyed to assess their opinions of the criteria they utilize to assign a diagnosis of PTSD to veterans of war.

Morgan, C. A., Rasmusson, A., Pietrzak, R. H., Coric, V., & Southwick, S. M. (2009). Relationships among plasma dehydroepiandrosterone and dehydroepiandrosterone sulfate, cortisol, symptoms of dissociation, and objective performance in humans exposed to underwater navigation stress. *Biological Psychiatry, 66*(4), 334-340.

This article discusses the research conducted on special operations Soldiers enrolled in the military Combat Diver Qualification Course (CDQC). The scientists found that Soldiers with more DHEA performed better than those with less DHEA.

Nestler, J. E., Isiskin, K. S., Barlascini, C. O., Welty, D. F., Clore, J. N., & Blackard, W. G. (1989). Suppression of serum dehydroepiandrosterone sulfate levels by insulin: An evaluation of possible mechanisms. *Journal of Clinical Endocrinology & Metabolism, 69*(5), 1040-1046.

This article is about a follow-up study used to determine whether a fall in serum DHEA-S levels might have been due to insulin-stimulated. The findings indicate that hyperinsulinemia reduces serum DHEA-S, DHEA.

Olsson, C. A., Bond, L., Burns, J. M., Vella-Brodrick, D. A., & Sawyer, S. M. (2003). Adolescent resilience: A concept analysis. *Journal of Adolescence, 26*(1), 1-11.

This article focused on the need for greater clarity around the concept of resilience as it relates to the period of adolescence. It examined the various terms used to conceptualize resilience. The goal was to explain core elements of resilience in more precise ways.

Ozbay, F., Johnson, D., Dimoulas, E., Morgan III, C. A., Charney, D., & Southwick, S. (2007). Social support and resilience to stress: From neurobiology to clinical practice. *Psychiatry, 4*(5), 35-40.

This article discusses how social support is essential for maintaining physical and psychological health. Social support may suppress genetic and environmental vulnerabilities and promote resilience.

Richman, J. M., & Fraser, M. W. (2001). *The Context of Youth Violence: Resilience, Risk, and Protection* (pp. 13-14). West Port: Praeger Publishers.

This book is about the current research on risk, protection, and resilience in the context of youth violence. It describes the emerging support for understanding social and health problems and for developing more effective programs for interventions.

Sapolsky, R.M., Romero, M., & Munck, A.U. (2000). How do glucocorticoids influence stress response? Integrating permissive, suppressive, stimulatory, and preparative actions. *Endocrine Reviews, 21*(1), 55-89.

This article reviews the role of glucocorticoids in allowing, suppressing or stimulating a stress response and examines its action in a number of areas to include immunity, cardiovascular effects and metabolism. The article also discusses underlying molecular actions of glucocorticoids.

Schulz, P., Kirshbaum, C., Prubner, J., & Hellhammer, D. (1998). Increased free cortisol secretion after awakening in chronically stressed individuals due to work overload. *Stress and Health, 14*(2), 91-97.

This study investigated the association between chronic stress and cortisol changes during the first hour after awakening in the morning. The results of the study showed that chronically stressed subjects had a significantly larger increase in cortisol (+15.5 nmol/l) compared to unstressed subjects (+9.1 nmol/l).

Shalev, A. Y., Peri, T., Canetti, L., & Schreiber, S. (1996). Predictors of PTSD in injured trauma survivors: A prospective study. *The American Journal of Psychiatry*, *153*(2), 219-226.

This article was about the relationship between immediate and short-term responses to a trauma and the subsequent development of PTSD. It also discussed an individual's personality and mental condition before exposure to a traumatic event that effect the risk of developing PTSD.

Smyth, J., Ockenfels, M. C., Porter, L., Kirschbaum, C., Hellhammer, D. H., & Stone, A. A. (1998). Stressors and mood measured on a momentary basis are associated with salivary cortisol secretion. *Psychoneuroendocrinology*, *23*(4), 353-370.

This study measured effects of stress on cortisol levels. Researchers took a sample of saliva for cortisol analysis twenty minutes after each assessment . Both the experience of a current stressor and anticipating a stressor were associated with increased salivary cortisol levels.

Yehuda, R. (2002). Post-traumatic stress disorder. *The New England Journal of Medicine, 346*(2), 108-114.

This article examined the traumatic events that occurred in the past such as the terrorist attacks on the World Trade Center and the Pentagon on September 11, 2001. It discussed the effects the attacks had on the survivors and defined what qualifies as PTSD.

Zatzick, D. F., Marmar, C. R., Weiss, D. S., & Browner, W. S. (1997). Posttraumatic stress disorder and functioning and quality of life outcomes in a nationally representative sample of male Vietnam veterans. *The American Journal of Psychiatry, 154*(12), 1690-1696.

This article focused on PTSD and the relationship between functioning and quality of life. It suggests that the suffering associated with combat related-PTSD extends beyond the signs and symptoms of the disorder to broader areas of functioning and social morbidity, therefore diminishing quality of life.